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CRETACEOUS MICROPLANKTON FROM THE EUCLA BASIN, WESTERN AUSTRALIA

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Introduction

This paper is concerned with the systematic description of microplankton species found in Cretaceous strata from the Western Australian portion of the Eucla Basin. The samples all come from the Madura Shale encountered in three bores, one (Madura 1) drilled by the Public Works Department for water, the other two (Eyre No. 1 and Gambanga No. 1) oil exploration wells. The geographic co-ordinates of the bores are given below (see Lowry 1968, Pl. 20 for map)—

Madura 1 bore	31°54′35″S., 127°00′20″E.
Gambanga No. 1 well	32°16′S., 124°50′E.
Eyre No. 1 well	32°07′S., 126°58′E.

The first stratigraphic and palaeontological work on these bores was done by Ludbrook (1958, 1960). Ingram (1968) examined the spores, pollen grains and microplankton and recognized three zones within the Madura Shale. These zones were considered (a) Senonian, (b) Albian-Cenomanian and (c) Neocomian-Aptian in age. In this paper samples from only the two youngest zones have been examined.

Systematic Descriptions

The registered numbers given for holotypes and hypotypes are those of the palynological Collection of the Geological Survey of Western Australia

Order DINOFLAGELLATA

Family GYMNODINIACEAE (Bergh) Schütt 1896

Genus **Dinogymnium** Evitt, Clarke & Verdier 1967

Dinogymnium cf. **acuminatum** Evitt, Clarke & Verdier 1967

(Pl. 10, fig. 1, F7932)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore at 968-988 ft.

COMMENT: Two specimens from the Madura Bore, Eucla Basin, Western Australia agree closely with those of *D. acuminatum* Evitt et al. 1967. The only difference seems to be the more rounded shape of their antapices.

DIMENSIONS: *c.* 68 μ long, *c.* 44 μ broad.

Dinogymnium westralium (Cookson & Eisenack 1958)

(Pl. 10, fig. 2, F7933)

Gymnodinium westralium Cookson & Eisenack 1958, p. 25, Pl. 1, fig. 9.
Dinogymnium westralium (Cookson & Eisenack) Ingram 1968, p. 65.

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 963-968 ft, Gambanga No. 1 Bore, Eucla Basin, Western Australia, at 910-920 ft.

COMMENT: Two features not observable in the specimens originally described from several Western Australian Cretaceous deposits have been evident in the one from the Madura Bore figured herein, namely the helicoid nature of the girdle and the presence of a very narrow longitudinal furrow.

Dinogymnium undulosum n. sp.

(Pl. 10, fig. 3; holotype, F7934)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 963-968 ft.

DESCRIPTION: Epitheca and hypotheca of nearly equal length with rounded apices, that of the hypotheca being the more strongly so, and clearly ornamented with wavy longitudinal ridges. Girdle prominent, circular in outline, rather shallow but with well-defined limits. The longitudinal furrow, which is present on both epitheca and hypotheca, narrows distally but does not extend to the poles.

DIMENSIONS: Holotype, *c.* 64 μ long, 34 μ broad. Range of four examples: length 52-70 μ, breadth 27-38 μ.

Dinogymnium sp. forma A

(Pl. 10, fig. 5, F7939)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 963-968 ft.

DIMENSIONS: *c.* 56 μ long, 30 μ broad.

COMMENT: The single specimen shown in Pl. 10, fig. 5 appears to be distinct, but since it is the only one of its kind so far found and is also incomplete, we have refrained from giving it specific rank. As the figure shows, it is roughly oval in shape and both the epitheca and hypotheca are ornamented with long, closely arranged wavy ridges, particularly so in the epitheca. However, more examples will be necessary for specific determination.

Dinogymnium cerviculum n. sp.

(Pl. 10, fig. 6; holotype, F7937)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 963-968 ft.

DESCRIPTION: Shell small, epitheca approximately three times as long as the hypotheca, narrowing gradually from the relatively deep, circular girdle to a distinct though short, straight-sided neck, the apex of which appears to have been detached along a straight line. Hypotheca in the form of a low half-sphere.

The surface of both epitheca and hypotheca is rather faintly longitudinally striated, especially that of the hypotheca, the striation being most conspicuous near the base of the epitheca. The longitudinal furrow appears to be developed as the result of the downward curving of the girdle.

DIMENSIONS: Holotype: shell *c.* 33 μ long, *c.* 27 μ broad, overall length *c.* 40 μ.

Dinogymnium cf. **cerviculum**

(Pl. 10, fig. 7, F7932)

Comment: A second specimen from the Madura No. 1 Bore at 963-968 ft seems to be closely related to *D. cerviculum*. However, its characters are not sufficiently clearly defined for specific identification. The surface of the shell appears to be smooth and the neck, which is relatively long, seems to be closed.

Dimensions: *c.* 52 μ long, *c.* 30 μ broad.

Dinogymnium cf. **avellana** (Lejeune-Carpentier 1951)

(Pl. 10, fig. 8, F7939)

Age and Occurrence: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 1018-1072 ft.

Comment: The figured specimen agrees in general form and shape with the one described by Lejeune-Carpentier from a Belgian Senonian flint. The poles of both epitheca and hypotheca are rounded in outline and the girdle is shallow, helicoid and laevo-rotatory with low but distinct borders. The longitudinal furrow, which is restricted to the hypotheca, does not extend to the antapex. Low but rather indistinct ridges are evident on both the epi- and hypotheca.

Dimensions: *c.* 44 μ long, 35 μ broad.

Dinogymnium euclaensis n. sp.

(Pl. 10, fig. 9-12; holotype, fig. 12, F7943)

Age and Occurrence: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft.

Description: Shell small, consisting of a conical, longitudinally striated epitheca and a smooth hypotheca about three-quarters of a sphere in outline. The two portions are separated by a rather deep, circular, transverse girdle, the ends of which form a longitudinal furrow which extends downwards for varying distances but not to the antapex.

Dimensions: Holotype, *c.* 34 μ long, *c.* 22 μ wide. Range of 14 specimens: 32-42 μ long, 19-30 μ broad.

Comment: The epithecal striations may be straight or somewhat wavy in outline. In one of the figured specimens (Pl. 10, fig. 11) a small portion of the apex has been removed, and in an unfigured one is completely so. However, at present, it is not possible to decide whether this is a natural or accidental phenomenon.

Dinogymnium cf. **euclaensis**

(Pl. 10, fig. 4, F7935)

Age and Occurrence: Senonian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, at 910-920 ft.

Dimensions: *c.* 37 μ long, *c.* 20 μ broad.

Comment: The single specimen from the Gambanga Bore, though similar in general form to that of *D. euclaensis* as described here (p. 139), differs from this species in having an unstriated epitheca with somewhat concave sides.

The small dark spot and upwardly curved thickening on the surface of the epitheca just above the longitudinal furrow is of interest since the whole feature is reminiscent of the longitudinal 'flagellum pore' of some of the fossil Dinoflagellates mentioned previously by Cookson & Eisenack 1968 and later herein.

Family DEFLANDREAECEAE Eisenack 1954

Genus **Deflandrea** Eisenack 1938

Deflandrea gambangensis n. sp.

(Pl. 11, figs. 1, 2; holotype, fig. 1, F 7950; paratype, fig. 2, F7951)

AGE AND OCCURRENCE: Senonian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, at 910-920 ft.

DESCRIPTION: Shell slightly longer than broad, partially filled by a relatively large internal capsule, with a smooth wall, which extends from a variable distance from the base of the hypotheca well into the epitheca.

The epitheca has a slightly wavy outline and a short apical horn, which, when entire, is bluntly-pointed (fig. 2). When, as sometimes happens, the extreme tip is missing a slight concavity is evident. The sides of the hypotheca, which are straight or slightly convex, slant downwards towards the point of origin of the single, short, but prominent antapical horn present on the left-hand side. A girdle seems to be absent, but slight concavities sometimes evident on the two sides where the shell is broadest, may indicate its existence. The archeopyle is intercalary, relatively large, rounded hoof-shaped with a straight base.

The surface of the epitheca is finely dotted with minute thickenings, which are arranged in longitudinal rows which slant from the girdle region towards the apex. Typically a small, somewhat triangular area between the top of the archeopyle and the apex is unornamented. Occasionally a slight, fine ornamentation of the hypotheca has been observed.

DIMENSIONS: Holotype: *c.* 86 μ long, 68 μ broad. Range of 10 examples: *c.* 86-105 μ long, 68-81 μ broad.

Deflandrea madurensis n. sp.

(Pl. 11, figs. 3, 4; holotype, fig. 3, F7952; paratype, fig. 4, F7953)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft.

DESCRIPTION: Shell longer than broad, epitheca somewhat larger than hypotheca with outwardly slanting sides and a small apical horn. The sides of the hypotheca slant towards a very small antapical horn which is situated on the left-hand side of the antapex. A large circular internal capsule almost fills the hypotheca and extends to nearly half way up the epitheca.

The archeopyle is intercalary, relatively large and rounded in outline with a straight base. The wall of the epitheca is typically completely and closely covered with small dot-like thickenings. A girdle has been clearly evident on the ventral surface of the paratype (Pl. 11, fig. 4).

DIMENSIONS: Holotype: *c.* 90 μ long, 72 μ broad. Range of 10 specimens: *c.* 74-96 μ long, 60-84 μ broad.

COMMENT: *D. madurensis* is obviously very closely related to the above described *D. gambangensis* (Pl. 11, fig. 2). However, the main distinguishing characters, namely the more complete filling of the hypotheca by the internal capsule, the smaller size and different shape of the antapical projection, and the more complete and denser arrangement of the surface thickenings, have been so constant in their occurrence that, for the present at least, the specific separation of these two forms, adopted herein, seems justified.

Deflandrea spinosissima n. sp.

(Pl. 11, figs. 5, 6; holotype, fig. 5, F7954; paratype, fig. 6, F7955)

AGE AND OCCURRENCE: Senonian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, at 910-920 ft.

DESCRIPTION: Shell moderately large with slanting to convex sides in both epitheca and hypotheca; a short, blunt apical horn and a single short antapical horn on one side. A large internal body either partially or almost entirely fills the hypotheca and part of the epitheca. The archeopyle is broadly triangular to almost circular in outline. The whole surface of the shell is densely and very finely spinulose.

DIMENSIONS: Holotype: *c.* 100 μ long, 72 μ broad. Range: shell *c.* 60-115 μ long, 44-87 μ broad.

COMMENT: One of the chief characters of this species is the occurrence of the fine ornament all over the shell.

Deflandrea multispinosa n. sp.

(Pl. 11, fig. 7-9; holotype, fig. 8, F7957; paratype, fig. 9, F7958)

AGE AND OCCURRENCE: Albian-Cenomanian. Madura No. 1 Bore between 1523-1775 ft.

DESCRIPTION: Shell small, slightly longer than broad. Epitheca somewhat larger than the hypotheca with slightly convex sides and a short, centrally placed apical horn which, when entire, is bluntly pointed. The sides of the hypotheca, which are straight or slightly convex, slant downwards towards a relatively narrow and straight base with two short but distinct antapical horns of unequal length, the left-hand one being the larger. In two specimens only one relatively large antapical horn is developed (Pl. 11, fig. 7). The girdle is prominent, circular and discontinuous on the dorsal surface, the breaks being to the right and left of a median portion and near the lateral walls. The wall of the shell is distinctly and closely ornamented with short, sharply pointed spines.

A large internal capsule, oval in shape, almost fills the shell. The archeopyle is squarish to circular in outline.

DIMENSIONS: Holotype: *c.* 96 μ long, 62 μ broad. Range of 10 specimens: *c.* 67-102 μ long, 46-72 μ broad.

COMMENT: The slight broadening of the epitheca below the apical horn and the lateral interruptions of the girdle on the dorsal surface are characters which, to some extent, link *D. multispinosa* with *D. tripartita* Cookson & Eisenack 1960, *D. victoriensis* Cookson & Manum 1964, *D. verrucosa* Manum (1963) and *D. manumi* n. sp.

Deflandrea manumi n. sp.

(Pl. 11, figs. 10, 11; holotype, fig. 10, F7959)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, between 963 and 968 ft.

DESCRIPTION: Shell relatively large, considerably longer than broad, divided approximately equally by a clearly-defined discontinuous girdle. The epitheca, which is slightly longer than the hypotheca, consists of a prominent apical region with strongly convex shoulder-like sides, a short, broad, median apical horn with a straight apex and outwardly slanting sides, and a slightly broader lower portion with convex sides which extends to the girdle. The sides of the hypotheca narrow gradually inwards towards a squarish antapex with a slightly pointed prominence on the right-hand side.

The girdle is relatively wide, strongly defined and broken at regular intervals. The archeopyle is rather large and slightly angular in outline.

The wall of the shell is finely granular throughout. In addition, relatively large clearly-defined areas both above and below the individual subdivisions of the girdle, which resemble fields of *Peridinium* type (Manum 1963), are outlined by relatively prominent, closely arranged, bluntly-pointed solid thickenings which are circular in outline in surface view.

The walls of the central body and shell are thin and in close contact.

DIMENSIONS: Holotype: *c.* 102 μ long, *c.* 60 μ broad. Range: 20 specimens *c.* 95-138 μ long, *c.* 52-80 μ broad.

COMMENT: Both the shape and the size of the shell of *D. manumi* are closely similar to those of *D. tripartita* Cookson & Eisenack 1960, *D. victoriensis* Manum & Cookson 1964 and *D. verrucosa* Manum 1963, and show the *Peridinium* type of tabulation discussed by Manum in 1963. The fields outlined on the surface of the shell of *D. manumi* are 3″, 4″ and 5″ and 2‴, 3‴ and 4‴. Between the individual fields there are clearly marked longitudinal intercalary strips.

Deflandrea balmei Cookson & Eisenack 1962

(Pl. 11, fig. 12, F7961)

Deflandrea minor Cookson & Eisenack 1960, p. 2, Pl. 1, fig. 1-4.
Deflandrea balmei Cookson & Eisenack 1962, p. 486, new name.

AGE AND OCCURRENCE: Probably Upper to Middle Senonian. Molecap Greensand north of Gingin, Western Australia, Wapet's seismic shothole B1 and 170 ft. Upper Gearle Siltstone *c.* 2505-2511 ft. Madura Bore No. 1, Eucla Basin, Western Australia, at 968-988 ft.

DIMENSIONS: Figured specimen: *c.* 52 μ long, *c.* 40 μ broad.

COMMENT: The Madura examples, five in number, agree well with the type specimen of this species from Rough Range South, Western Australia, No. 1 Bore at 2505-2511 ft.

Deflandrea balcattensis Cookson & Eisenack 1969

(Pl. 11, fig. 13, F6630)

AGE AND OCCURRENCE: Albian-Cenomanian. Balcatta Bore No. 1, Western Australia, between 120-160 ft and 230-270 ft. Senonian: Madura No. 1 Bore, Eucla Basin, Western Australia, between 1073-1104 ft.

COMMENT: The figured specimen completely agrees in shape and structure with those from the Balcatta No. 1 Bore, Western Australia. As in the earlier examples, the wavy longitudinal thickening which marks the position of the flagellum pore is clearly evident.

Deflandrea armata n. sp.

(holotype, Pl. 13, fig. 9, F7986)

AGE AND OCCURRENCE: Senonian. Gambanga Bore No. 1, Eucla Basin, Western Australia, 910-920 ft.

DESCRIPTION: Shell longer than broad with a rather dome-shaped epitheca with convex sides which narrow towards a short apical horn. Hypotheca somewhat longer than the epitheca with slightly convex sides which slant slightly towards a relatively broad slanting antapex with a small antapical horn on the right-hand side. The longitudinal furrow, which is relatively broad, widens antapically. The surface of the shell is covered with short, clearly-defined, broadly-based spines.

The internal capsule is thin-walled and in the holotype, Pl. 13, fig. 9, appears to be restricted to the middle region of the shell, which it fills laterally. In the unfigured paratype the capsule appears to fill the greater portion of the shell.

DIMENSIONS: Holotype: *c.* 80 μ long, 57 μ broad. Range of several specimens: length *c.* 67-80 μ, breadth 48-57 μ.

Deflandrea ingrami n. sp.

(Pl. 12, fig. 7-9; holotype, Pl. 12, fig. 9, F7971)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft.

DESCRIPTION: Shell rather flat, approximately oval in outline with a thin, untabulated wall, and a small, flat, median apical projection on the left-hand side. Slight lateral concavities indicative of a transverse girdle are evident in the holotype.

A large oval capsule almost fills the shell both laterally and longitudinally. Its wall is slightly thicker than that of the shell and appears to be ornamented with small, closely arranged, low, dot-like thickenings (Pl. 12, fig. 8).

A six-sided archeopyle is outlined in the apical region of the epitheca of the holotype and the example shown in Pl. 12, fig. 8.

DIMENSIONS: Holotype: length *c.* 67 μ, breadth 48 μ. Paratype: *c.* 75 μ × 56 μ. Range: length *c.* 68-80 μ, breadth 46-66 μ.

COMMENT: A relatively frequent species. In the holotype the wavy longitudinal thickening associated with the flagellum (herein, p. 153) is present in the region of the ventral furrow.

Deflandrea rhombovalis n. sp.

(Pl. 12, figs. 10, 11; holotype, Pl. 12, fig. 11, F7973)

AGE AND OCCURRENCE: Senonian to Cenomanian-Albian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft, 1073-1104 ft.

DESCRIPTION: Shell small, somewhat flat, rounded-rhomboidal to nearly oval in outline, with a short, blunt to truncate apical horn and a small, pointed to rounded antapical horn situated towards one side of the hypotheca. Girdle median, slightly indicated or missing. In the holotype the ventral furrow is in evidence and the wavy thickening which we associate with the flagellum pore and have herein recorded for several other types (p. ??) is clearly indicated.

The capsule is approximately circular in outline and does not fill the shell laterally; its wall is only slightly thicker than that of the shell. The shell opens by means of a small, approximately five-sided archeopyle, as is evident in the holotype, but to one side of the epitheca due to faulty preservation.

DIMENSIONS: Based on 20 examples. Holotype: length *c.* 54 μ, breadth 44 μ. Range: length *c.* 46-56 μ, breadth 36-44 μ.

COMMENT: The differences between this species and other small and smooth species of *Deflandrea* are the blunt, truncate and slightly inverted apical horn and the pointed antapical horn.

Genus **Palaeohystrichophora** Deflandre 1934

Palaeohystrichophora infusorioides Deflandre 1936

(Pl. 12, figs. 12, 13)

Palaeohystrichophora infusorioides Deflandre 1936, p. 38.
Palaeohystrichophora infusorioides Deflandre, Cookson & Eisenack 1958, p. 37.
Palaeohystrichophora infusorioides Deflandre, Cookson & Hughes 1964, p. 43, Pl. 5, fig. 8.
Palaeohystrichophora infusorioides Deflandre, Manum & Cookson 1964, p. 43, Pl. 5, fig. 5.
Palaeohystrichophora infusorioides Deflandre, Clarke & Verdier 1967, p. 28, Pl. 4, fig. 10.
Palaeohystrichophora infusorioides Deflandre, Ingram 1968, p. 66.

COMMENT: *P. infusorioides,* originally described by Deflandre in 1934 from French Upper Cretaceous deposits and subsequently recorded from Australian deposits of approximately the same age by Cookson and Eisenack in 1958 and recently by Ingram (1968) of Albian to Upper Senonian age, has occurred regularly in the Madura No. 1 Bore, Eucla Basin, Western Australia, between 963-1104 ft. The most interesting feature of the specimens examined during the present investigation has been the presence of the clearly defined, small, wavy, longitudinal thickening on the surface of the middle portion of the wide ventral furrow, which we believe to have been associated with a flagellum, and which is similar to those recorded herein for species of the genera *Deflandrea, Dinogymnium,* ? *Ascodinium trendalli,* etc.

Genus **Spinidinium** Cookson & Eisenack 1962

Spinidinium lanterna n. sp.

(Pl. 12, fig. 1-3; holotype, fig. 2, F7964)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, 968-988 ft.

DESCRIPTION: Shell somewhat biconical, clearly divided by a relatively conspicuous girdle into a longer epitheca with straight to slightly convex slanting sides and a short apical horn and a shorter, somewhat broader hypotheca with slanting, slightly convex sides and a narrow, pointed antapical horn to one side of the midline. The girdle is relatively broad, interrupted laterally on the dorsal surface, its ends on the ventral surface being rather widely separated.

The tabulation, which is most evident in the epitheca, is difficult to determine. The plates appear to be long, narrow and triangular in outline and to extend from the girdle to near the apex. There seem to be six precingular plates in the epitheca; the number in the hypotheca has not been determined. However, in several specimens, a small semicircular area, outlined by a single row of small, evenly-spaced thickenings, which extends between the two lateral breaks in the girdle, has been evident on the dorsal surface of the hypotheca (Pl. 12, fig. 2).

The outlines of both the shell and plates are ornamented with distinctly pointed spines which vary somewhat, both in size and density, in individual specimens.

The archeopyle is small, intercalary and high in the epitheca. The internal body is large, thin and smooth-walled and, except at the extreme apex, almost fills the shell.

DIMENSIONS based on 20 examples: Holotype: length *c.* 70 μ, breadth 50 μ. Range: *c.* 55-78 μ long, 37-57 μ broad.

COMMENT: Although the outer wall of *Spinidinium lanterna* is clearly tabulated and the species not uncommon, it has not been possible to determine the exact tabulation. The main features by which *S. lanterna* can be distinguished from *S. stylonifera* Cookson & Eisenack 1962 from Western and South Australian Aptian and Albian deposits are: the greater difference between the lengths of the epitheca and hypotheca, straighter sides, clearer tabulation, longer and more clearly outlined triangular plates and the finer type of ornamentation.

Genus **Ascodinium** Cookson & Eisenack 1960

Ascodinium ovalis n. sp.

(Pl. 13, fig. 8; holotype, F7985)

AGE AND OCCURRENCE: Albian to Cenomanian. Madura No. 1 Bore, 1471-1486 ft.

DESCRIPTION: Shell smooth, slightly flattened, oval in outline, thin-walled, with a large apical archeopyle and a short antapical projection slightly to one side of the antapex.

Capsule completely separated from the wall of the shell with a relatively thin, unornamented wall except at both apex and antapex, where small dot-like thickenings are evident. The capsule opens by the complete detachment of the apex.

DIMENSIONS: Holotype: shell *c.* 35 μ long, *c.* 40 μ broad. Capsule *c.* 40 $\times$ 35 μ.

COMMENT: The holotype is the only example of this type so far found. In it the apical portions of both shell and capsule have been detached. The detached apex of the capsule gives a good idea of the type of ornament mentioned above.

The method of opening of both shell and capsule is similar to that of the three species of *Ascodinium* previously recorded from Western Australian Albian-Cenomanian deposits (Cookson & Eisenack 1960, p. 5).

Genus ? **Ascodinium** Cookson & Eisenack 1960

? **Ascodinium trendalli** n. sp.

(Pl. 12, figs. 5, 6; holotype, fig. 5, F7967)

AGE AND OCCURRENCE: Senonian, Albian-Cenomanian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft and 1073-1104 ft.

DESCRIPTION: Shell distinctly longer than broad, rather thin-walled, untabulated and very finely and inconspicuously dotted, with a bluntly pointed median apical projection and a downwardly slanting antapex with a short ± sharply pointed projection on the right-hand side. A well-developed subequatorial girdle delimits a longer epitheca from a shorter hypotheca, its ends on the ventral surface being widely separated.

The internal capsule, which is distinctly oval in shape and relatively large, extends to the outer wall of the hypotheca but not quite to that of the epitheca. Its wall appears to be somewhat thicker than that of the shell.

On the ventral surface of the hypotheca, between the ends of the girdle, the longitudinal wavy thickening, probably associated with the flagellum pore, is usually prominent. An archeopyle has not been observed.

DIMENSIONS: Holotype: Overall length *c.* 70 μ, overall width 35 μ, internal capsule *c.* 38 $\times$ 30 μ. Range: length *c.* 67-93 μ, breadth *c.* 33-50 μ.

COMMENT: In none of the many specimens examined (30 actually mounted) has an archeopyle been observed. In a few examples the apex of the shell has been partially or entirely removed but in none has the internal capsule been opened, nor the breach sufficiently clean-cut to suggest that it was due to a natural method of opening. For this reason, the present assignment of this readily recognizable form to the genus *Ascodinium* is regarded as provisional. In this respect, attention needs to be drawn to three of the Western Australian Dinoflagellate species, referred to the genus *Deflandrea,* namely *D. rotundata* Eisenack & Cookson 1960, *D. foliacea* Eisenack & Cookson 1960, *D. balcattensis* Cookson & Eisenack 1969, in which archeopyles were not evident in the many examples studied.

As to the well-developed wavy thickening present in the mid-ventral surface of the hypotheca of ? *A. trendalli,* which appears to be similar to those associated with the flagellae of recent Dinoflagellates, we have not been able to prove that a definite connection between them and the central body does exist. However, there seems little doubt that the clearly defined structure, so well represented in this species, is connected with the flagellum pore.

Family PSEUDOCERATIACEAE Eisenack 1961

Genus **Odontochitina** Deflandre 1935

Odontochitina cf. **striatoperforata** Cookson & Eisenack 1962

(Pl. 14, figs. 8, 9, F8007, 8008)

COMMENT: A few incomplete speimens comparable with some of those figured from the type Cretaceous localities in Western Australia have been found in the Madura Bore sample at 966-968 ft.

Family CANNINGIACEAE Sarjeant & Downie 1966

Genus **Canningia** Cookson & Eisenack 1960

Canningia scabrose n. sp.

(Pl. 13, figs. 6, 7; holotype, Pl. 13, fig. 6, F7983)

AGE AND OCCURRENCE: Albian-Cenomanian. Madura No. 1 Bore, 1486-1523 ft. Senonian: Madura No. 1 Bore, 968-988 ft.

DESCRIPTION: Shell rather flat, almost circular to slightly angular in outline, with a slight apical prominence and with, as in the holotype, or without a slight antapical concavity bounded by blunt or pointed outgrowths.

In one example (from 1486-1523 ft) a girdle is clearly evident on the ventral surface. The shell opens by the removal of a considerable portion of the epitheca.

The ornamentation consists of densely arranged, irregularly outlined thickenings, some of which narrow to short, hair-like appendages (Pl. 13, fig. 4).

DIMENSIONS: Holotype: *c.* 102 μ long, 90 μ broad. Range in breadth: *c.* 78-94 μ.

Family APTEODINIACEAE Eisenack 1961

Genus **Apteodinium** Eisenack 1958

Apteodinium tuberculatum n. sp.

(Pl. 12, fig. 14; holotype, F7976)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore at 1073-1104 ft.

DESCRIPTION: Shell untabulated, relatively large, broadly oval in outline with a short, solid, median apical horn which narrows from a relatively broad base to a small apex ornamented by a small terminal and two minute lateral spiny projections. A relatively wide, median, spiral girdle is clearly outlined, and a large archeopyle occupies a considerable portion of the epitheca. The surface of the shell is ornamented with low, closely arranged, somewhat spinous thickenings.

DIMENSIONS: Holotype: *c.* 128 μ long, 105 μ broad.

COMMENT: Three additional specimens were recovered which, whilst agreeing with the general characters of the holotype, were less suitable for exact measurements. *A. tuberculatum* is rather closely similar to *A. maculatum* (Eisenack & Cookson 1960a, p. 4) from Aptian and Albian deposits in Western Australia, South Australia and Queensland. However, it differs from this species in the less rounded shape of the shell, the shape of the apical horn and the absence of the group of well-characterized thickenings typical of *A. maculatum*.

Family ACTINOTHECACEAE n. fam.

Shell roughly circular in outline consisting of a flat, somewhat hexagonal body and a broad two-layered wing which is supported by a series of narrow radially directed thickenings. Type of the family is the genus *Actinotheca* Cookson & Eisenack 1960.

COMMENT: The family Actinothecaceae includes Dinoflagellates or Dinoflagellate cysts which are considerably flattened in the direction of the longitudinal axis. The flattened central body represents the capsule and the wing the outer layer as in cavate cysts. The six parts of the wing correspond to six precingular plates between two of which the longitudinal furrow is developed.

In 1966 Sarjeant and Downie proposed that the genus *Actinotheca* should be referred to the Stephodiniaceae. However, the construction of *Actinotheca* is quite distinct from that of *Stephodinium* Deflandre 1936. In this genus the capsule is situated eccentrically and extends both above and below the wing, the archeopyle being in the epitheca. In *Actinotheca* the capsule and outer layer lie in the same plane.

Genus **Actinotheca** Cookson & Eisenack 1960

Actinotheca ornata n. sp.

(Pl. 13, figs. 1, 2; holotype, fig. 1, F7978)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft.

DESCRIPTION: Main characters are those of the genotype, *A. aphroditae* Cookson & Eisenack 1960 from the Turonian, Lower Gearle Siltstone, Western Australia, at 2500-2514 ft. The only difference shown by the Madura specimens is the presence of a few, relatively large, evenly-spaced appendanges with simple or slightly forked apices, which arise from a circular area about half-way from the centre of the body of the shell and also from the surface of the wing. A longitudinal furrow is present in the paratype (Pl. 13, fig. 2).

DIMENSIONS: Holotype: Diameter of shell *c.* 75 μ, overall diameter *c.* 125 μ. Range of five specimens: Diameter of shell *c.* 48-77 μ, overall diameter *c.* 88-125 μ. Length of appendages *c.* 7-30 μ.

Family HYSTRICHOSPHAERIDIACEAE Evitt 1963 emend. Sarjeant & Downie 1966

Genus **Hystrichosphaeridium** Deflandre 1937 emend. Davey & Williams 1966

Hystrichosphaeridium tubiferum (Ehrenberg)

(Pl. 14, fig. 2, F8001)

Xanthidium tubiferum Ehrenberg, 1838, Pl. 1, fig. 16.
Hystrichosphaeridium tubiferum (Ehrenberg) Lejeune-Carpentier 1940, p. 218, fig. 1-4.
Hystrichosphaeridium tubiferum (Ehrenberg) Davey & Williams 1966, p. 56, Pl. 6, figs. 1, 2, Pl. 9, fig. 5.
Hystrichosphaeridium tubiferum (Ehrenberg) Wilson 1966, p. 223-240.
Hystrichosphaeridium tubiferum (Ehrenberg) Davey 1969, p. 43, Pl. 5, figs. 5, 8.

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft and 1075-1104 ft.

DIMENSIONS: Diameter of shell *c.* 52-70 μ; overall diameter *c.* 104-133 μ.

COMMENT: The apex of one of the appendages in the figured specimen appears to be closed, a feature not hitherto recorded for this type. The Western Australian examples are appreciably larger than the holotype and paratype of this species (Davey & Williams 1966, p. 56).

Hystrichosphaeridium recurvatum (White 1842) Lejeune-Carpentier 1940

(Pl. 14, fig. 1, F8000)

Xanthidium recurvatum (1842) 1844 *Trans. Micr. Soc.* 1: Pl. 8, fig. 11.
Hystrichosphaeridium recurvatum (White) Lejeune-Carpentier 1940. *Ann. Soc. geol. Belg.* 63: 221, fig. 6.
Hystrichosphaeridium recurvatum (White) Deflandre & Cookson 1955. *Aust. J. mar. Freshwat. Res.* 4: No. 2, Pl. 1, figs. 11, 12.
Hystrichosphaeridium recurvatum (White) Lejeune-Carpentier, Davey, Downie, Sarjeant & Williams 1966, p. 67.

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, 1078-1104 ft.

DIMENSIONS: Figured specimen, diameter of shell *c.* 35 μ, overall diameter *c.* 85 μ, number of appendages 30.

COMMENT: Some well-preserved specimens from the Madura Bore agree with the descriptions of *H. recurvatum* by Lejeune-Carpentier (1940) including the number of appendages (30) as evidenced by the figured specimen. All the Madura examples have been larger than the holotype of the closely related form *Hystrichosphaeridium sheppeyense* Davey & Williams 1966, p. 69, Pl. 11, fig. 3.

Genus **Oligosphaeridium** Davey & Williams 1966

Oligosphaeridium pulcherrimum (Deflandre & Cookson 1955)

(Pl. 14, fig. 3, F8002)

Hystrichosphaeridium pulcherrimum Deflandre & Cookson 1955, p. 270, Pl. 1, fig. 8, text-fig. 21.
Hystrichosphaeridium pulcherrimum Deflandre & Cookson 1955, Valensi 1955, p. 592, Pl. 4, fig. 1.
Oligosphaeridium pulcherrimum (Deflandre & Cookson) Davey & Williams 1966, p. 75, Pl. 10, fig. 9, Pl. 11, fig. 5.
Oligosphaeridium pulcherrimum (Deflandre & Cookson) Cookson & Eisenack 1968, p, 114, fig. 4E.

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1078-1104 ft.

DIMENSIONS: Diameter of shell of figured specimen *c.* 60 μ, overall diameter *c.* 124 μ.

COMMENT: The figured specimen has a clearly defined, six-sided apical archeopyle. The first Western Australian record of *O. pulcherrimum* was recently made (Cookson & Eisenack 1968) from Gingin Brook No. 4 Borehole, Western Australia, between 202 and 204 ft, the age of which is suggested as either lowest Campanian or possibly Santonian (A. E. Cockbain in Sanders 1967, p. 30).

Genus **Heterosphaeridium** Cookson & Eisenack 1968

Heterosphaeridium conjunctum Cookson & Eisenack 1968

(Pl. 14, fig. 5-7, F8004-6)

Heterosphaeridium conjunctum Cookson & Eisenack 1968, p. 115, fig. 4G-H.

Age and Occurrence: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft and 1018-1072 ft.

Dimensions: Complete specimen (Pl. 14, fig. 5): length of shell including apical horn *c.* 118 μ, overall length with antapical appendages *c.* 130 μ; width of shell *c.* 90 μ, overall width *c.* 118 μ.

Comment: The specimen shown in Pl 14, fig. 5, is the only complete one of this species so far found. It shows the partial detachment of the apical portion including the horn. The characteristic ledges uniting the bases of the appendages are particularly evident.

H. conjunctum was first recovered by Cookson and Eisenack in 1968 from the silty limestone intersected by the Gingin Brook No. 4 Bore, Western Australia, between 202 and 204 ft, the age of which is either lowest Campanian or possibly Santonian (Cockbain in Sanders 1967, p. 30).

Genus **Diphyes** Cookson 1965

Diphyes appendicularis n. sp.

(Pl. 13, fig. 5, F7982)

Age and Occurrence: Senonian. Madura No. 1 Bore, 963-966 ft.

Description: Shell composed of two portions of very unequal size. The anterior portion is large, probably originally spherical, and closely covered with relatively small appendages which narrow from broadish bases to almost hair-like distal apices. The much smaller posterior portion is in the form of a relatively prominent, hollow, unornamented projection, longer than broad, with a slightly serrated rim.

Dimensions: Holotype: overall length *c.* 90 μ, overall breadth 95 μ, antapical projection *c.* 31 μ long, *c.* 23 μ broad at base, narrowing to *c.* 13 μ, and widening again to *c.* 18 μ at the extremity.

Comment: The two specimens of *D. appendicularis* from the Madura No. 1 Bore differ from the type species *D. colligerum* Cookson 1965 from Victorian Tertiary and Upper Cretaceous deposits in the extreme difference in size that exists between the two portions of the shell. In addition, the type of appendage is quite distinct from that of *D. colligerum.*

? Family EXOCHOSPHAERIDIACEAE Sarjeant & Downie 1966

? Genus **Exochosphaeridium** Davey, Downie, Sarjeant & Williams 1966

? **Exosphaeridium phragmites** Davey, Downie, Sarjeant & Williams

(Pl. 14, fig. 4, F8003)

Exosphaeridium phragmites Davey, Downie, Sarjeant & Williams 1966, p. 165, Pl. 2, fig. 8-10.
Exosphaeridium phragmites Davey, Downie, Sarjeant & Williams. Davey 1969, p. 163, Pl. 7, fig. 5.

Age and Occurrence: Senonian, Albian-Cenomanian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1078-1104, 1471-1486, 1486-1523 ft.

Dimensions: Figured specimen, shell *c.* 42 × 50 μ, overall diameter *c.* 72 × 79 μ. Range: Diameter of shell *c.* 36-42 μ, overall diameter *c.* 57-108 μ.

Comment: The Western Australian specimens herein tentatively referred to *E. phragmites* from Cenomanian deposits in Surrey, England, agree with this type in the form of the shell, the solid nature of the sharply-pointed and broadly-based appendanges and the precingular position of the archeopyle. In contrast the surface of the shell of Australian specimens has been smooth to slightly granular, not pitted as in the type material. In ? *E. phragmites* the archeopyle is five or six-sided. Sometimes two or three appendages are confluent basically resulting in a broad bifid appendage.

Family Uncertain

Genus **Maduradinium** n. gen.

DESCRIPTION: Shell five-sided to nearly circular in outline with a readily detachable apical horn and one or two antapical projections. Girdle relatively wide, circular in outline with more or less strongly developed borders and a wide ventral furrow. The archeopyle is relatively large, precingular, six-sided with a straight to somewhat rounded outline.

Surface of shell finely granular, typically with scattered patches of more or less strongly developed, closely arranged thickenings, especially in the vicinity of the apex, antapex and girdle.

Genotype **Maduradinium pentagonum** n. sp.

(Pl. 10, fig. 13-17; holotype, Pl. 10, fig. 13, F7944; paratype, Pl. 10, fig. 14, F7945)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore at 968 ft.

DESCRIPTION (based on the holotype and paratype): Shell broader than long, approximately five-sided, divided by a wide, strongly outlined girdle into two approximately equal parts. The sides of the epitheca are slightly convex and, in the holotype, a short, centrally placed horn is present. The sides of the hypotheca slant inwards towards a slightly sloping antapex with a small prominence on either side, the right-hand one being the stronger. The girdle is wide, strongly outlined and its ends on the ventral surface are widely separated. The archeopyle is relatively large, six-sided and clearly outlined. The surface ornamentation consists of patches of dot-like thickenings of variable shape and size which are most strongly developed below the apex, near the lateral portions of the girdle and near the antapex.

DIMENSIONS: Holotype: *c.* 85 μ long, *c.* 95 μ wide. Paratype: *c.* 81 × 100 μ. Range: length *c.* 80-103 μ, breadth *c.* 78-105 μ.

COMMENT: From the considerable variation, both in shape and degree of ornamentation of the shell that is shown by the figured specimens at present included in *M. pentagonum*, it is evident that considerably more examples will be needed for the establishment of the specific limits within this genus. Eight specimens have been studied, all of which have the same straight, six-sided archeopyle, the loss in seven of them of the apical horn, as in the paratype, and a prominence on one side of the antapex.

The broken specimen is included to illustrate the mode of detachment of the apical horn.

Family MEMBRANILARNACIACAE Eisenack 1969

Genus **Chlamydophorella** Cookson & Eisenack 1958

Chlamydophorella apiculata n. sp.

(Pl. 13, fig. 3; holotype, F7980)

AGE AND OCCURRENCE: Albian-Cenomanian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, core 7, 1055-1075 ft.

DESCRIPTION: Shell oval, surmounted by a small apical projection with a blunt tip. General surface rather densely covered with short, slightly capitate appendages that are most prominent in the antapical region, shorter and relatively indistinct towards the apex and completely absent from the apical horn. The appendages are enveloped in a thin membrane. In the equatorial region they appear to diverge slightly, possibly due to the existence of an indistinct girdle. No indication of an archeopyle is present.

Dimensions: Holotype: Shell without horn *c.* 60 μ, with horn *c.* 70 μ. Overall length *c.* 75 μ, overall breadth *c.* 50 μ, length of appendages *c.* 4-6 μ.

Comment: Only one example has been found.

Chlamydophorella lagena n. sp.

(Pl. 13, fig. 4; holotype, F7981)

Age and Occurrence: Albian-Cenomanian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, core 7, 1055-1065 ft.

Description: Shell approximately oval in outline with a relatively wide, squarish, apical projection. The whole surface covered with numerous short, rod-like appendages which support a continuous covering membrane. No indication of either a girdle or archeopyle is evident.

Dimensions: Holotype: Shell *c.* 52 μ long, *c.* 35 μ wide. Overall length *c.* 62 μ, overall breadth *c.* 40 μ.

Comment: Only one example has been found.

Incertae Sedis

Group Acritarcha Evitt 1963

Subgroup Herkomorphitae

Genus **Cymatiosphaera** O. Wetzel 1933

Cymatiosphaera radiata O. Wetzel 1933 emend. Deflandre 1954

(Pl. 13, fig. 13, F7990)

Age and Occurrence: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 966-988 ft.

Dimensions: Figured specimen, diameter of shell *c.* 27 μ, overall diameter *c.* 42 μ, height of ledges *c.* 55 μ.

Comment: Two specimens referable to this species have been recovered, one of them closely resembles those described by Cookson & Eisenack 1960, p. 9, Pl. 2, fig. 22. The other, shown herein, has somewhat thinner and more numerous ledges.

Cymatiosphaera densa n. sp.

(Pl. 12, fig. 15, F7977)

Age and Occurrence: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 966-968 ft.

Description: Shell small, spherical, covered with low, closely arranged ledges which cross one another forming small polygonal areas with wavy outlines resulting in a labyrinthic pattern.

Dimensions: Holotype: Shell *c.* 30 μ, overall diameter *c.* 42 μ, height of ledges *c.* 5 μ.

Comment: More specimens will be needed for the determination of the detailed structure of this form.

Subgroup POLYGONOMORPHITAE Downie, Evitt & Sarjeant 1963

Genus **Veryhachium** Deunff 1954 emended Downie & Sarjeant 1963

Veryhachium reductum (Deunff 1959)

Veryhachium trisulcum Deunff var. *reductum* Deunff 1959, p. 27, Pl. 1, fig. 8-11.
Veryhachium reductum (Deunff) Jekhowsky 1961, p. 210-212, Pl. 2, fig. 22-37.
Veryhachium reductum (Deunff) Brosius & Bitterli 1961, p. 36, Pl. 1, fig. 3-6.
Veryhachium reductum (Deunff) Cookson & Eisenack 1962, p. 492, Pl. 4, fig. 16.
Veryhachium reductum (Deunff) Cookson & Hughes 1964, p. 56, Pl. 11, fig. 8.
Veryhachium reductum (Deunff) Cookson & Eisenack 1969, p. 122, Fig. 5P.

COMMENT: This species, a widely distributed type, is represented in the deeper layers of the Madura No. 1 Bore, Eucla Basin, Western Australia.

Veryhachium sp.

(Pl. 13, fig. 12)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft.

DESCRIPTION: Shell spherical with 8 or 9 long, slender pointed appendages, the cavities of which communicate with the interior of the shell. The walls of both shell and appendages are smooth and relatively thick.

DIMENSIONS: Figured specimen: Diameter of shell *c.* 24 μ, overall diameter *c.* 70 μ.

Subgroup Uncertain

Genus **Palaeostomocystis** Deflandre 1935

Palaeostomocystis apiculata Cookson & Eisenack 1960

(Pl. 13, fig. 10, F7987)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 966-988 ft.

COMMENT: The Madura examples are approximately equal in size to that of the original type specimens from the Brickhouse Bore, Western Australia.

DIMENSIONS: The figured specimen is *c.* 54 μ long and *c.* 27 μ broad.

Palaeostomocystis chytra Drugg 1967

(Pl. 13, fig. 11, F7988)

AGE AND OCCURRENCE: Senonian. Madura No. 1 Bore, Eucla Basin, Western Australia, 966-988 ft.

COMMENT: The Madura Bore examples agree closely with those recorded by Drugg (1967) from the Escarpado Canyon, California. Two of them have shown the mode of opening of the shell by the detachment of the apical wall.

Object A. Genus and species indeterminate

(Pl. 13, fig. 14, F7991)

AGE AND OCCURRENCE: Albian-Cenomanian. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 1055-1065 ft. × *c.* 500.

DESCRIPTION: Shell flat, circular in outline, smooth and untabulated with a few relatively short, radially arranged appendages which widen slightly distally, towards straight finely-serrated edges. The appendages seem to be arranged in two sets and in two planes, the upper and lower surfaces being unornamented.

DIMENSIONS: Shell *c.* 50 μ, length 76 μ, breadth 77 μ.

COMMENT: This object seems to represent a new type possibly related to the genus *Actinotheca* Cookson & Eisenack 1960. However, since the specimen is incomplete, more examples will be necessary for generic placing.

Concluding Remarks

An interesting result of the present investigation has been the relatively frequent occurrence, in several Dinoflagellate genera, of the wavy, or less frequently, ear-shaped thickening on the ventral surface, between the ends of the girdle, which we regard as being associated with the flagellum.

Since the first record (Cookson & Eisenack 1958) this feature has been clearly evident in several Australian Cretaceous and Lower Tertiary species but in spite of good preservation the actual flagellar pore that penetrates the shell itself has not, as yet, been observed.

Records of the occurrence of this feature are as follows:

Gonyaulacysta diaphanis (Cookson & Eisenack 1958, p. 36). South Perth Formation (Lower Cretaceous), Attadale Bore, Western Australia, at 999 ft.

Ginginodinium tabulatum Cookson & Eisenack 1965, p. 143, Pl. 19, figs. 5, 6. Paleocene: Pebble Point Formation, SW. side of Dilwyn Bay, Victoria, 30 ft above base of the formation.

Dinogymnium cf. *euclaensis* Cookson & Eisenack 1970, Pl. 10, fig. 4. Senonian: Gambanga No. 1 Bore, Eucla Basin, Western Australia, at 910-920 ft.

Palaeohystrichophora infusorioides Deflandre 1936. Cookson & Eisenack 1970. Madura No. 1 Bore, 963-1104 ft. Pl. 12, fig. 12, 13.

Deflandrea phosphoritica Eisenack 1938. Cookson & Eisenack 1965, p. 121, Pl. 11, fig. 11. Upper Eocene: Brown Creek Clay, SW. Victoria, carbonaceous clay 25 ft below the Greensand (infrequent) to gritty clay 45-50 ft above the Greensand (numerous) inclusive.

Deflandrea pentaradiata Cookson & Eisenack 1965b, p. 139, Pl. 18, fig. 1. Paleocene: Pebble Point Formation, Victoria, 4-6 ft above base.

Deflandrea deliniata Cookson & Eisenack 1965c, p. 140, Pl. 18, fig. 4. Fig. 1a. Paleocene: Pebble Point Formation, Victoria, 4 ft above base.

Deflandrea balcattensis Cookson & Eisenack 1970, Pl. 11, fig. 13. Senonian: Albian-Cenomanian: Osborne Formation, Balcatta No. 1 Bore, Western Australia.

Deflandrea balcattensis Cookson & Eisenack 1970, Pl. 11, fig. 13. Senonian: Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft.

Deflandrea rhombovalis Cookson & Eisenack 1970, Pl. 12, fig. 11. Senonian: Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft.

Deflandrea ingrami Cookson & Eisenack 1970. Pl. 12, fig. 9. Senonian: Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft.

Deflandre dartmooria Cookson & Eisenack 1965a, Fig. 1a, Pl. 16, fig. 1.

? *Ascodinium trendalli* Cookson & Eisenack 1970, Pl. 12, fig. 6. Senonian: Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft.

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Explanation of Plates

Plate 10

Fig. 1—*Dinogymnium* cf. *acuminatum* Evitt, Clarke & Verdier 1967. Madura No. 1 Bore, 963-968 ft × *c.* 700.

Fig. 2—*Dinogymnium westralium* Cookson & Eisenack 1958. Gambanga No. 1 Bore, 910-920 ft. × *c.* 700.

Fig. 3—*Dinogymnium undulosum* n. sp. Madura No. 1 Bore, 963-968 ft. Holotype × *c.* 700.

Fig. 4—*Dinogymnium* cf. *euclaensis.* Gambanga No. 1 Bore, 910-920 ft × *c.* 700.

Fig. 5—*Dinogymnium* sp. forma A. Madura No. 1 Bore, 963-968 ft × *c.* 1,000.

Fig. 6—*Dinogymnium cerviculum* n. sp. Madura No. 1 Bore, 963-968 ft. Holotype × *c.* 700.

Fig. 7—*Dinogymnium* cf. *cerviculum.* Madura No. 1 Bore, 963-968 ft × *c.* 700.

Fig. 8—*Dinogymnium* cf. *avellana* Lejeune-Carpentier 1951. Madura No. 1 Bore, 1018-1072 ft × *c.* 700.

Fig. 9-12—*Dinogymnium euclaensis* n. sp. Madura No. 1 Bore, 963-968 ft. Holotype Fig. 12 × *c.* 700.

Fig. 13-17—*Maduradinium pentagonum* n. sp. Madura No. 1 Bore, 968-988 ft. Holotype Fig. 13 × *c.* 500; Paratype Fig. 14 × *c.* 500.

Plate 11

Fig. 1, 2—*Deflandrea gambangensis* n. sp. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 910-920 ft. Holotype Fig. 1 × *c.* 700, Fig. 2 × *c.* 500.

Fig. 3, 4—*Deflandrea maduraensis* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 966-988 ft. Holotype Fig. 3 × *c.* 700, Fig 4 × *c.* 350.

Fig. 5, 6—*Deflandrea spinosissima* n. sp. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 910-920 ft. Holotype Fig. 5 × *c.* 500, Paratype Fig. 6 × *c.* 500.

Fig. 7-9—*Deflandrea multispinosa* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1523-1775 ft. Holotype Fig. 8 × *c.* 500, Fig. 7, 9 × *c.* 500.

Fig. 10-11—*Deflandrea manumi* n. sp. Madura No. 1 Bore, 963-968 ft. Holotype Fig. 10 × *c.* 700, Fig. 11, Paratype, × *c.* 500.

Fig. 12—*Deflandrea balmei* Cookson & Eisenack. Madura No. 1 Bore, Eucla Basin, Western Australia, at 968-988 ft × *c.* 700.

Fig. 13—*Deflandrea balcattensis* Cookson & Eisenack. Madura No. 1 Bore, Eucla Basin, Western Australia, at 1073-1104 ft × *c.* 700.

Plate 12

Fig. 1-4—*Spinidinium lanternum* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft, × *c.* 700. Fig. 2, ventral surface of holotype.

Fig. 5, 6—? *Ascodinium trendalli* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft. Fig. 5, ventral surface of holotype × *c.* 1,000; Fig. 6, portion of another specimen to show the wavy thickening probably associated with a flagellum × *c.* 1,400.

Fig. 7-9—*Deflandrea ingrami* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 963-968 ft. Fig. 9, Holotype showing 'flagellar' thickening × *c.* 700; Fig. 8, Paratype, dorsal surface showing archeopyle; Fig. 7, specimen showing evidence of a girdle × *c.* 700.

Fig. 10, 11—*Deflandrea rhombovalis* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft. Holotype Fig. 11 × *c.* 700, Paratype Fig. 10 × *c.* 700.

Fig. 12, 13— *Palaeohystrichophora infusorioides* Deflandre 1934. Madura No. 1 Bore, Eucla Basin, Western Australia, showing 'flagellar' thickening. Fig. 12 × *c.* 700, Fig 13 × *c.* 1,000.

Fig. 14—*Apteodinium tuberculatum* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft. Holotype × *c.* 350.

Fig. 15—*Cymatiosphaera densa* n. sp. Madura No. 1 Bore, Western Australia, 968-988 ft × *c.* 700.

Plate 13

Fig. 1, 2—*Actinotheca ornata* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1073-1104 ft. Fig. 1, Holotype, × *c.* 500; Fig. 2, Paratype, × *c.* 500.

Fig. 3—*Chlamydophorella apiculata* n. sp. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 1055-1065 ft. Holotype × *c.* 700.

Fig. 4—*Chlamydophorella lagena* n. sp. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 1055-1065 ft. Holotype × *c.* 700.

Fig. 5—*Diphyes appendicularis* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 963-968 ft. Holotype × *c.* 700.

Fig. 6, 7—*Canningia scabrosa* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft. Fig. 6, Holotype, × *c.* 500.

Fig. 8—*Ascodinium ovalis* n. sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1471-1486 ft. Holotype × *c.* 700.

Fig. 9—*Deflandrea armata* n. sp. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 910-920 ft. Fig. 9, Holotype, × *c.* 700.

Fig. 10—*Palaeostomocystis apiculata* Cookson & Eisenack 1960. Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft × *c.* 700.

Fig. 11—*Palaeostomocystis chytra* Drugg 1967. Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft. × *c.* 700.

Fig. 12—*Veryhachium* sp. Madura No. 1 Bore, Eucla Basin, Western Australia, 1018-1072 ft × *c.* 350.

Fig. 13—*Cymatiosphaera radiata* O. Wetzel 1933. Madura No. 1 Bore, Eucla Basin, Western Australia, 968-988 ft × *c.* 700.

Fig. 14—Object A. gen. and sp. indeterminate. Gambanga No. 1 Bore, Eucla Basin, Western Australia, 1055-1065 ft × *c.* 500.

PLATE 14

Fig. 1—*Hystrichosphaeridium recurvatum* (White 1842). Madura No. 1 Bore, Western Australia, 1078-1104 ft × *c.* 700.

Fig. 2—*Hystrichosphaeridium tubiferum* (Ehrenberg 1838). Madura No. 1 Bore, 1078-1104 ft × *c.* 700.

Fig. 3—*Oligosphaeridium pulcherrinum* (Deflandre & Cookson 1955). Madura No. 1 Bore, 1078-1104 ft × *c.* 500.

Fig. 4—? *Exochosphaeridium phragmites* Davey, Downie, Sarjeant & Williams 1961. Madura No. 1 Bore, 1471-1486 ft × *c.* 700.

Fig. 5-7—*Heterosphaeridium conjunctum* Cookson & Eisenack 1968. Madura No. 1 Bore, 966-988 ft. Fig. 5, complete specimen with apical portion in process of detachment × *c.* 500. Fig. 6, open shell showing polygonal ledges uniting the bases of appendages and polygonal areas between them × *c.* 500. Fig. 7, single broad longitudinally striated appendage × *c.* 500.

Fig. 8-9—*Odontochitina striatoperforata* Cookson & Eisenack 1962. Madura No. 1 Bore, 966-988 ft. Fig. 8, detached apical horn × *c.* 350. Fig. 9, opened shell with antapical horns × *c.* 350.